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GLAST LAT

Calorimeter Subsystem

Process Specification for the Bonding of the PIN Photodiode Subassembly to the CsI Crystals

DOCUMENT APPROVAL

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes	DCN #
1		Developmental Release	

Table of Contents

1.0 Scope

This specification establishes the requirements for bonding PIN Photodiode Assemblies (PDAs) to the Crystal surface using low out-gassing and optically clear non-conductive silicone adhesives. The processes for bonding are qualified for 100 thermal cycles ranging in temperature from -30 to +50°C.

2.0 Applicable Documents

The following documents form a part of this specification to the extent specified herein. If no revision is indicated, the latest issue in effect is applicable.

2.1 Government Documents

STANDARDS

MIL-STD-45662	Calibration Systems Requirements
NASA-STD-8739.7	Electrostatic Discharge Control

2.2 Non-Government Documents

SWALES AEROSPACE DRAWINGS

B7340	Assembly, Bond Set-up Engineering Model, CDE
B7344	Assembly, Mold & PDA Engineering Model, CDE
B7560	Assembly, Channel Engineering Model, CDE
B7562	Assembly, Bond Workstation, Engineering Model, CDE

PROJECT DOCUMENTS

GSFC-433-MAR-0004	GLAST Missions Assurance Requirements for the Large Area Telescope Phase C/D/E
LAT-MD-00228-D2	GLAST LAT CAL, TKR, & DAQ Contamination Control Plan
LAT-MD-00039-1	LAT Performance Assurance Implementation Plan
LAT-SS-00820-D1	LAT Calorimeter CsI Crystal Performance Specification
LAT-DS-00209-02	Specification for the CAL Dual PIN Photodiode Assembly (Flight Units)
LAT-DS-00072	Specification for the Calorimeter PIN Photodiode Assembly (Engineering Model)
LAT- PS-00809-01	LAT Calorimeter Crystal Handling and Shipping Procedure

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASQC Zi .4	Sampling Procedures and Tables for Inspection by Attributes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D2240	Identification hardness of plastics by means of durometer
D1002	Standard Test Method for Strength properties of adhesives in shear by tension

3.0 Requirements

3.1 Workmanship

3.1.1 Appearance

There shall be no evidence of voids, cracks, or bubbles in the bond. The cured bonding material shall be uniform in appearance, and clean and free of foreign materials. There shall be no excess adhesive on the outside periphery of the PIN Photodiode Assembly (PDA) and the crystal surface. The PDA consists of a set of four wires soldered to a PIN Photodiode. There shall be no evidence of discoloration or peeling on the bonded surfaces. The surface of the bonding shall be free of discoloration, grease, solvent films, or other contamination.

3.1.2 Bond and Adhesion Verification

The reason for measuring bond strength is to obtain a number that can compare the differences in adhesion between one formulation and treatment to another provided the crystal, PDA and environmental control procedures are same for each adhesion.

Adhesion strength is directly related to the testing speed, humidity, and temperature during the test. Therefore, it is necessary to record adhesion strength at different test speeds and temperature in order to characterize acceptable bonds.

The accuracy of the results of strength tests of adhesive bonds will depend on the conditions under which the bonding process is carried out and depends on the following variables, which shall be controlled during the bonding process:

1) Procedure for preparation of the surfaces prior to application of the adhesive, the cleaning and drying of surfaces, and special surface treatments such as sanding or use of a primer
2) Completeness of mixing directions for the adhesive
3) Conditions for application of the adhesive, including the rate of spread or thickness, number of coats to be applied
4) Assembly conditions before application of pressure using approved fixtures, including the room temperature and length of time
5) Curing conditions, including the amount of pressure to be applied using approved fixtures, the length of time under pressure, and the temperature of the crystals and PDA when under pressure
6) Conditioning procedure before testing including the duration of cure, temperature, and relative humidity

Adhesion of the PDA to the crystal shall be verified by lap shear strength test (paragraph 3.1.3), as defined in Appendix A, and tensile test/pull test (paragraph 3.1.4) as defined in Appendix B.

3.1.3 Lap Sheer Strength

The Lap Sheer Strength of the cure bond samples shall be no less than 60 psi. No less than two lap sheer coupons representing the hardware substrate material shall be processed concurrently with the parts they represent. The bond line thickness shall be within the tolerance range of 0.7mm ± 0.1mm. Coupons shall be processed with the representative parts of the crystal PDA assembly. Coupons shall also be cleaned using the same method as the flight assembly. Completed coupons prior to Lap Sheer test should be visually inspected for conformance to the workmanship requirements found in Section 3.1. The Test Procedure for lap shear testing of adhesive lap joints is detailed in Appendix A.

3.1.4 Tensile Test/Pull Test Verification

This test determines the tensile strength of the bond between the PDA and the crystal. The test consists of subjecting the PDA and crystal assembly to tensile load normal to the plane of the PDA. Such loads will be transmitted to the PDA through the thick bonding blocks bonded to the surface. The Test Procedure for tensile test/pull test is detailed in Appendix B

3.1.5 Hardness

The Type A durometer hardness of the cured adhesive samples shall be in the range of 35-45, Shore A.

3.2 Materials

Material vacuum out-gassing will be determined in accordance with ASTM E-595. In general, a material is qualified on a product-by-product basis. However, lot testing may be required of any material for which lot variation is suspected. In such cases, material approval is contingent upon lot testing. Only materials that have a total mass loss (TML) less than 1.00% and a collected volatile condensable mass (CVCM) less than 0.10% will be approved for use. The materials shall be in accordance with the following list:

Material	Source
Cyanoacrylate adhesive (for attaching tensile test fixtures as defined in Appendix B)	E Z Bonding Diamond Bar, CA
Silicone Resin, DC 93-500(part A)	Dow Corning
Curing agent, DC 93-500(part B)	Dow Corning
Primer, DC 92-023	Dow Corning (to be qualified for outgassing)
Ethyl Alcohol, 100%	Countyline Distillers, Bardstown, KY (or equivalent source)
Gloves, Nitrile, powder-free	Fisher Scientific Co., Pittsburgh, PA (or equivalent source)

Brush, Acid – 1/8 and 3/8	approved source
Wipes, Texwipe CleanCotton (or equivalent)	Texwipe Co., Hilsdale, NJ (or equivalent source)
Swabs, Foam, TX-700B (or equivalent)	Texwipe Co., Hilsdale, NJ (or equivalent source)
Swabs, Cotton cleanroom	approved source
Abrasion Cloth, Aluminum Oxide, 240 grit	approved source
Beaker, Polypropylene 250 cc	Fisher Scientific Co., Pittsburgh, PA (or equivalent source)
Stirring Rods, Polypropylene	approved source
Syringe, Polypropylene 5 cc & 10 cc (or equivalent)	approved source
Pipette, Glass Eyedropper	Fisher Scientific Co., Pittsburgh, PA (or equivalent source)
Dry Nitrogen	approved source

3.3 Equipment

Items required for the subject processes are as follows:

1. A lighted magnifier with 10X magnification used for visual inspections
2. A calibrated, laboratory centigram (0.01 gram) scale, used to measure material mixing proportions
3. A vacuum chamber or bell jar capable of operating at a vacuum level of 10 mm Hg or lower, used to degas adhesives.
4. A Shore hardness tester, Shore A. Shore A tester is used for verifying the cure hardness of the adhesive
5. ESD Approved Working Bench
6. ESD Wrist Straps and ESD Monitoring Station
7. Glue Gun
8. All bond and wrap tooling as described in the Swales Aerospace drawings B7340, B7344, B7560, and B7562.

   Note: For the verification of the crystal and PDA alignment, the four Teflon alignment pads (PN: B7074-5) located in the crystal support channel (PN: B7341) shall be re-measured at the RE's discretion to ensure that the pads are still within the allowable tolerance specified in the pads' drawings. Any alignment pads that are out of tolerance shall be replaced by a new approved pad before any further bonding process may be performed using that particular crystal channel.

3.4 Handling

3.4.1 Crystal handling

a) All crystals shall be traceable from procurement through receiving, processing, inspection, shipping, and delivery. When personnel action impacts traceability and identification, methods must be implemented to ensure traceability. Because the crystal itself does not contain a uniquely identifying mark, the shipping wrapper conveys the serial number. The shipping wrapper shall be maintained with the crystal at least until the diode bonding process is complete and documented, at which point traceability is maintained through the wire cable identifier. Whenever a crystal is removed from its wrapper, the supporting or working fixture that holds the crystal shall be labeled with the serial number. In addition, the crystal left/right, top/bottom orientation must be preserved during handling after the crystal is removed from the shipping wrapper.

b) It is the responsibility of all personnel to ensure that crystals are returned to their respective wraps and boxes after bonding. Each crystal shall be returned to its wrapper in the proper orientation, with the label on the "top" face – where the crystal is inscribed with a small V – and the characters on the label reading from left to right, where the "right" end is the end inscribed with the small V.

c) CsI crystals are malleable and ductile. The four long edges of the crystals have a chamfer that is critical for assembly. Forces exerted by hand can damage the chamfer. It is essential that the crystals be handled in such a way as to prevent damage or deterioration during all phases of operation. Crystals shall be supported by rigid mechanical structures during handling and transport. These supports shall be made of an aluminum channel covered with soft materials (such as Teflon or nylon).

d) Crystals can be distorted by mechanical shocks. Any shock should be reported to QA. No dimensional measurements shall be performed within seven days of the shock.

e) Only powder-free nitrile gloves shall be used while contacting or handling crystals. Crystals shall never be handled using bare hands.

f) The crystal temperature shall never be below the dew point of the environment surrounding the crystals.

g) Relative humidity (RH) shall be maintained below 45%. Prior to bonding with PDAs the RH of the crystal environment shall be maintained as low as practically possible.

h) If the humidity of the environment is beyond 45% for more than 2 hours, any humidifier in the workroom shall be shut down until the RH level is within the specification. QA shall be informed of this deviation immediately.

i) The crystals shall not be subject to temperature gradients greater than 10°C per hour.

j) Continuous temperature and humidity monitoring records for the bond work areas shall be maintained and shall be made available for review.

k) The crystals shall never be exposed to direct sunlight. Except during inspection, the exposure to bright lights should be kept at a minimum.

l) Any measurements of the optical properties of the crystals shall be performed not sooner than two hours after exposure to bright light.

m) Sharp objects shall not be used while handling or performing operations on the crystals, except as required and identified in approved procedures.

n) All tools shall be wiped clean with 100% ethanol prior to contact with the crystals.

o) All materials shall be handled in such a manner as to minimize exposure to humidity, skin oils, and contamination.

p) All work surfaces shall be kept free of noticeable dust and debris. Worktables shall be cleansed with 100% ethanol before use and covered with protective film or paper, as appropriate.

q) Where practical, tethered tools shall be used when working above the crystals.

r) Each crystal is received in a sealed and evacuated plastic bag. The bag shall be cut opened at one end with a pair of scissors and carefully slid off the crystal without lifting the crystal more than three inches from the work place (to minimize the risk of dropping a crystal and the likelihood of scratching the crystal surface).

s) Crystals shall be received from Sweden in approved containers. These containers shall have rigid outer surfaces, internal foam to absorb shocks, and rigid support structures for each crystal. If practical, the same containers shall be used to ship completed CDEs from Swales/France to the NRL.

t) To prevent temperature shock, the crystal boxes shall be stored in a temperature and humidity controlled environment for at least 36 hours without being opened.

u) When it is separated from the crystal, the protective Tyvek and aluminum foil wrapping shall be stored in a clean, environmentally controlled container for potential re-use.

v) All lifting equipment shall be tagged with rated capacity, proof load and date.

w) All lifting equipment shall be inspected for proper configuration, damage, and proof load / rating tags prior to lift.

x) Certified personnel shall perform all work.

y) During the lifting of boxes containing crystals, the immediate area shall be barricaded and cleared of non-essential personnel.

z) Individual boxes containing crystals in the box weighing 30 lbs or less may be handled manually or with the aid of a mechanical lifting device. However, crystal boxes weighing greater than 30 lbs shall always be lifted with a mechanical lifting device and with at least two personnel carrying out the task. The responsible engineer or his designee shall monitor the unpacking operation.

3.4.2 PDA Handling

a) To protect the PDAs and to prevent the package from absorbing moisture, avoid unpacking the PDAs until they are ready to be used. PDAs must be bonded within 24 hours after removal from ESD boxes.

b) Avoid touching the optical window, because dirt or scratches on the light input window might cause a loss of sensitivity. If the window needs to be cleaned, use ethyl alcohol and wipe off the window gently. Avoid using any other organic solvents other than ethyl alcohol as they may cause deterioration of the device's epoxy resin coating and may affect the performance.

c) Do not use the attached wire cable to lift the PDAs. The PDAs contain an unsupported soldered wire cable. Care should be taken during all handling to avoid pulling, bending, or twisting the wire cable in any manner or else the bonds within the PDA may be damaged.

d) PDAs are ESD sensitive. All personnel handling PDAs shall wear wrist straps and be grounded at all times as per NASA-STD-8739.7. ESD precautions as per NASA-STD-8739.7 shall be used for all bonding or handling operations

e) Avoid using any other organic solvents other than 100% ethyl alcohol as they may cause deterioration of the PIN photodiode optical epoxy resin coating and may affect the performance.

3.5 Electrostatic Discharge (ESD) Instructions

Electrostatic Discharge (ESD) controls will include the following requirements:

a) Protected areas and workstations will be established and verified by Quality Assurance personnel prior to their use.

b) Use of protective personnel clothing and proper personnel grounding at all necessary points where Electrostatic Discharge Sensitive (ESDS) items will be handled.

c) All personnel handling electrostatic discharge sensitive (ESDS) items should be certified to NASA-STD-8739.7

d) Handling and moving of the crystal and PIN Photodiode Assembly ESDS items shall be accomplished using appropriate ground straps, grounding chains, and/or protective packaging.

e) Electrostatic protective packaging requires the prevention of charge generation and protection from strong electrostatic fields. Materials used in protective bags for crystal and diode assembly shall be constructed from a conductive or static dissipative material.

f) All above mentioned crystal and PIN Photodiode assembly items received shall be examined for proper ESD precautionary marking and for ESD protective packaging. When any item is received that has not been protected during shipment or internal transfer, it shall be rejected as defective and processed as nonconforming material.

g) All crystal assemblies shall be transported to and from the area of storage in ESD dissipating protective boxes, bags or wrapped in conductive film.

h) Wrist straps shall be used when handling crystal assemblies.

i) Warning signs that can be seen before entering into the area identify protective areas. Access to such areas shall be limited to certified personnel. All other personnel shall be escorted and equipped with protective clothing, as required.

j) All work surfaces in ESD protected areas and at protective workstations shall be static dissipative and electrically connected to a common ground. Surface resistivity in the range of 1012 to 109 ohms/square. Work surfaces should be kept free of static generating materials (e.g., common plastics, Styrofoam, bubble pack, tape).

k) Air ionizers are not required but may be used to improve the work environment when the humidity is between 30 and 35% or when static generators cannot be avoided.

l) Grounding devices shall be available to all personnel working with or handling these assemblies to prevent the accumulation of ESD. All personnel coming within 3 feet of any ESD assembly shall wear a grounding device.

m) Wrist straps must be in contact with the wearer's skin. The safety resistor shall measure 1 meg-ohm (+/- 20%). Wrist strap monitors that alarm when the connection to ground is compromised are preferred.

n) The preferred practice for facilities ground is to use the third wire alternating current (AC) line ground for grounding all items at the ESD-protected workstation. When a separate grounding line is present or used in addition to the equipment ground, it should be bonded to the equipment ground at each ESD-protected workstation to minimize the difference in potential. The resistance of the conductor from the common point ground to the equipment AC ground should not be greater than 1.0 ohm.

o) Chairs and stools made of conductive or static dissipative materials are preferred.

p) The relative humidity shall be continuously monitored during time in which ESDS crystal assembly components are being handled. A minimum of 35% and a maximum of 45% relative humidity shall be maintained in the ESD controlled work area. The localized work area shall be surveyed to verify the %RH is between 35 to 45%. Localized air ionizers can also be used while the humidity is between 35 to 45%. Absolutely no work on the crystal assembly can be performed if the humidity drops below 35%. If the humidity drops below 35% (with localized monitoring) all work on ESDS crystal assembly components must stop until the humidity can be raised and maintained above the minimum limit before work can resume.

q) ESDS items, equipment, and assemblies shall be identified in compliance with the following requirements. Identification shall be placed so as to warn personnel before any ESD damaging procedure can be performed. Packing lists, inspection reports, travelers, and other paperwork accompanying the hardware shall contain ESDS labels and cautionary notes.

r) The electrical integrity of each wrist strap shall be checked each day (of use) at the beginning of the work shift. When a continuous wrist strap monitor is used, daily wrist strap checks are not required. The continuous monitor must have at least visual indication of the connection to ground status.

4.0 Bonding Procedure

In the one stage bond process, a total bond thickness of 0.7mm ±0.1mm is delivered in one mold injection process. Encased between the crystal holding fixture and injection mold, the PDA and its mask/bond frame form the desired bond geometry. This section details the procedure for the mold injection bond using Dow Corning DC93-500 adhesive parts A & B and DC92-023 primer.

4.1 General

All bonding and applying of primer, adhesive, etc., shall be performed in a reasonably clean area (preferably in a silicone safe class 100,000 clean-room) with adequate ventilation, good lighting and temperature and humidity control between 25°C ± 5°C and RH between 40% ± 5%. All pre-bonding procedures shall be performed a Class 100,000 or equivalent anteroom with a silicone safe flow bench venting to the air outside the building. Respiratory protection is not required if working with a local exhaust hood. All safety requirements prescribed in the Materials Safety Data Sheets (MSDS) must be followed in using, handling or mixing the materials listed in this specification. Personnel handling assembly hardware, and/or involved in the bonding operation must wear powder-free nitrile gloves. Care shall be exercised to avoid the possibility of introducing contamination in the compounds or onto the prepared surfaces.

All non-flight items being used in the cleaning or bonding of flight hardware shall be wiped by the use of Ethyl alcohol soaked clean room certified wipers to clean each item for 2 to 3 minutes. Wipe any loose particles adhering to the articles. Thoroughly dry the articles with clean room certified wipes and store the articles in a clean bag or cabinet free of contaminants, such as silicones, vinyl, hydrocarbons and particulates.

Mix log records shall be used for all processes and filled out in its entirety and shall be included on the Work Order Authorization (WOA) form.

4.2 Pre-Bonding Inspection

Before initiating bonding operations, each crystal and PDA shall be visually examined for damage and contamination, and acceptance data verified. Record in the WOA form and “CDE Logbook” the serial numbers of the crystals and PDAs to be used in the bonding process, noting which side of the crystal (+ or -) each PDA will be bonded.

The crystal identification number is affixed on the outside of the wrapper. The orientation of the label containing the ID number shall define the orientation of the crystal - the characters on the label read from left to right along the long axis of the crystal, and this direction shall define the "left" (or "minus") face and the "right" (or "plus") face of the crystal. Furthermore, the labeled face is called the “top” face. During crystal inspection in Kalmar, Sweden, the polished 26.7 mm x 326.0 mm top face is inscribed with a small, fiducial “V” arrow near to and pointing toward the right face. This right arrow shall provide a reference orientation for all-further crystal processing. See Figure 1 below for references.

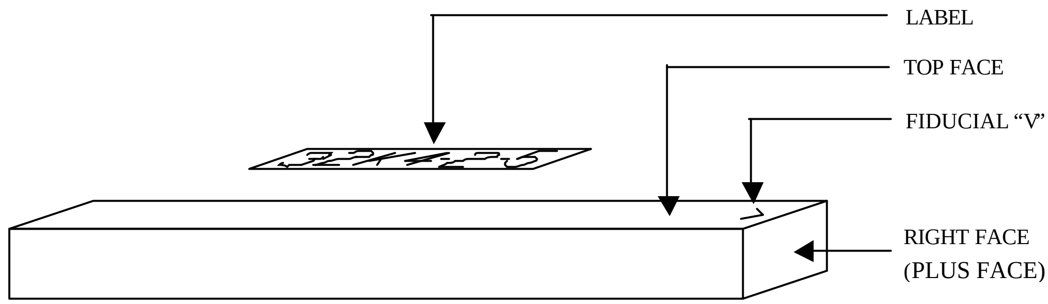


Figure 1: Crystal Labeling and Orientation Detail

4.3 Bonding Preparations: Clean and Abrade

Begin each bonding day by recording the anteroom and clean-room temperatures, relative humidity (RH) and dew point in the "Mix Log Record Form" and attach this form the WOA once the bonding procedure is completed for the day.

> **CAUTION: The Thallium-doped Cesium Iodide, CsI (TD) crystals are sensitive to relative humidity, and hence it is necessary to prevent condensation from forming on the crystals. The following environmental conditions are required for the storage and handling of the crystals:**

- The environment shall be maintained at a temperature range of 25°C +/- 5°C
- RH shall be maintained within 40% +/- 5° %
- The crystal temperature shall never be below the dew point in the room.
- If the humidity of the environment is beyond 45% for more than 2 hours, adjustments must be made to correct the environment's conditions.

  (See "GLAST LAT CAL, TKR, & DAQ Contamination Control Plan" (LAT-MD-00228-D2) for details.)

Clean all plastic stirring rods, beakers, syringes and all syringe tips using an approved clean-room cloth and 100% ethyl alcohol. (All plastic tools used in this bonding process are made of approved Polypropylene, which does not react with adhesives).

Prepared surfaces shall be handled only with clean, un-powdered nitrile gloves. If parts are not primed immediately after cleaning, they shall be protected from dust, dirt, and other contamination.

4.3.1 Crystal Preparation

For maximum adhesion between contact surfaces, the crystal surface must be cleaned in areas where the adhesives are to be applied. Surface contamination must be removed from the surface for maximum bond strength. Once the crystal bonding surface is cleaned, it must be kept clean and free of contamination at all times until the bonding process is performed.

CAUTION: The CsI crystal will be integrated into the bond set-up from this step forward. All personnel handling the crystal shall follow the crystal handling instructions defined in Section 3.4.1 of this document.

1. Remove the crystal from its protective Tyvek sleeve.
2. Using a prepared VM2000 sleeve that is approximately 24cm long, insert the crystal into the sleeve so that the crystal is protected throughout the bonding process.

   NOTE: *For the Engineering Model (EM) CDEs, Step 3 will be performed at NRL. For the Flight Model (FM) CDEs, this step is omitted since the crystals' bonding surfaces are abraded by the crystal Supplier*

3. Lightly abrade the crystal's bonding surfaces at one end in a random circular motion using dry 240-grit aluminum oxide paper for 10-15 seconds. Wipe away CsI (Tl) dust with a clean-room cloth and a clean, dry acid brush. Blow abraded surface with dry nitrogen to remove any remaining dust. Finish the cleaning process by wiping the abraded surface with a clean-room cloth moisten with 100% ethyl alcohol to remove any residual residue. Repeat the abrading and cleaning procedure on the opposite face.
4. Clean the abraded crystal surface that is to be bonded with a clean-room swab moistened with 100% ethyl alcohol to remove particulates and debris. Avoid spreading alcohol onto the side faces.
5. Allow the surface to air dry for several minutes before continuing the bond process. Dry nitrogen may be used to decrease drying time. The crystal bonding surface is now clean and ready for bonding.

CAUTION: ESD sensitive hardware is being handled from this step forward. All personnel handling hardware shall wear wrist straps and be grounded at all times as per NASA-STD-8739.7. ESD precautions as defined in paragraph 3.5 shall be used for all bonding and handling operations.

4.3.2 PIN Photodiode Assembly (PDA) Preparation

For maximum adhesion between contact surfaces, the PDA surface must be cleaned in areas where the adhesives are to be applied. Surface contamination shall be removed from the PDA for maximum bond strength. Once the PDA bonding surface is cleaned, it must be kept clean and free of contamination at all times until the bonding process is performed.

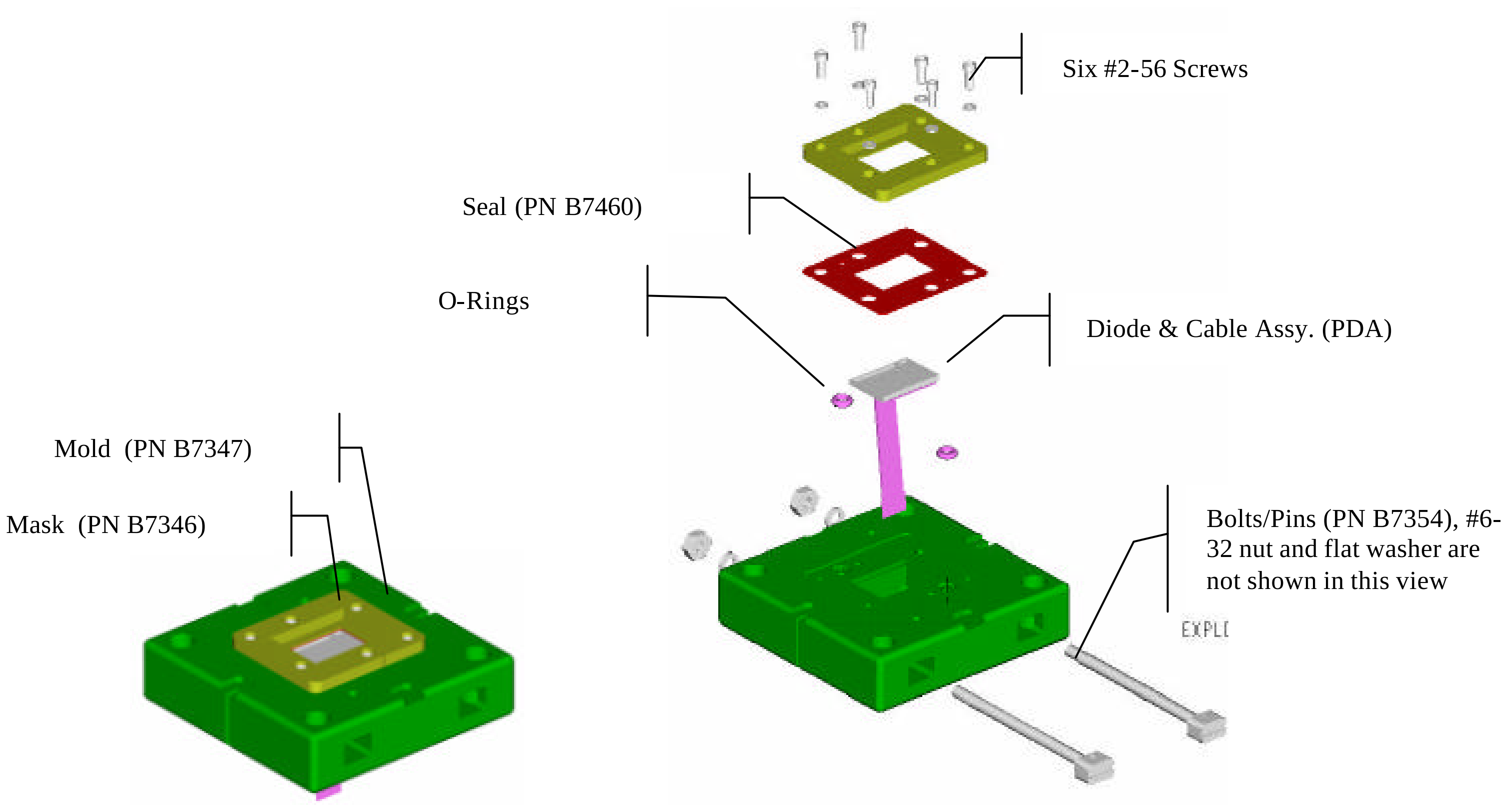
1. Clean the diode's bonding surface using 100% ethyl alcohol and a clean-room swab to remove any oils, dirt or particulates.
2. Allow the cleaned PDA surface to air dry for several minutes before continuing the bond process. Dry nitrogen may be used to decrease drying time. The PDA bonding surface is now clean and ready for bonding.

4.4 Setting Up the PIN Photodiode Assembly (PDA)

1. Create one subassembly, "Assembly, Mold & PDA" (PN: B7344-1), of the PDA to be bonded as shown in Figure 2a & 2b. The B7344-1 subassembly should contain the following items:

   - One split mask (PN: B7346)
   - One split seal (PN: B7460)
   - One split mold assembled (PN: B7347)
   - Two o-rings
   - One PDA unit

NOTE: *The proper orientation of the photodiode in the mold is VERY IMPORTANT. Improper placement will orient the wire cable in an incorrect direction. Position the diode in the Teflon mold such that the diode pins are located on the same side as the #6-32 hex nuts for the split mold. SAI drawing B7344 marks the mold for proper diode orientation. (See drawing for details.) Precautions to avoid damage or stress on the wires attached to the PDA shall be taken.*



Figures 2a & 2b:

PN – B7344-1 Diode & Mold Subassembly; Unexploded & Exploded Views Shown

2. Tighten the two pin/bolts (PN: B7354) using washers and nuts to clamp the split mold together. Tighten the six #2-56 screws to seal the diode in place. (See Swales assembly

drawing, B7344, for details.) Visually inspect the subassembly to ensure that the diode, mask and seal are resting in the mold properly and that there are no gaps or over lapping of any kind between the mold, mask and seal since this will compromise the seal and can potentially cause leakage. Set subassembly aside for next level integration.

3. Assemble the halves of a second mold (PN: B7347) by using two pin/bolts (PN: B7354), two #6 flat washers and two #6-32 hex nuts. Tighten all hardware. Set second mold aside for the next level of integration.
4. Assemble a mask (PN: B7346) only to the second mold. (Do not assemble a diode or seal to this subassembly as it shall only be used to cap off the bond set-up and not bonded to at this time. This shall be known from this point forward as an "empty" mold, B7344-3). Secure the mask in place by tightening six #2-56 screws.

4.5 Setting Up the Crystal

1. Create the crystal's bonding set-up (PN: B7340) as shown in Figure 3 by first assembling the empty mold (PN: B7344-3) to one end of a support channel (PN: B7560); this is the end that will not be bonded at this time. Use the four #¼-20 shoulder bolts, compression springs, and washers to secure the mold flush to the end surface of the support channel. See Swales Aerospace bond set-up assembly drawing B7340 for details.

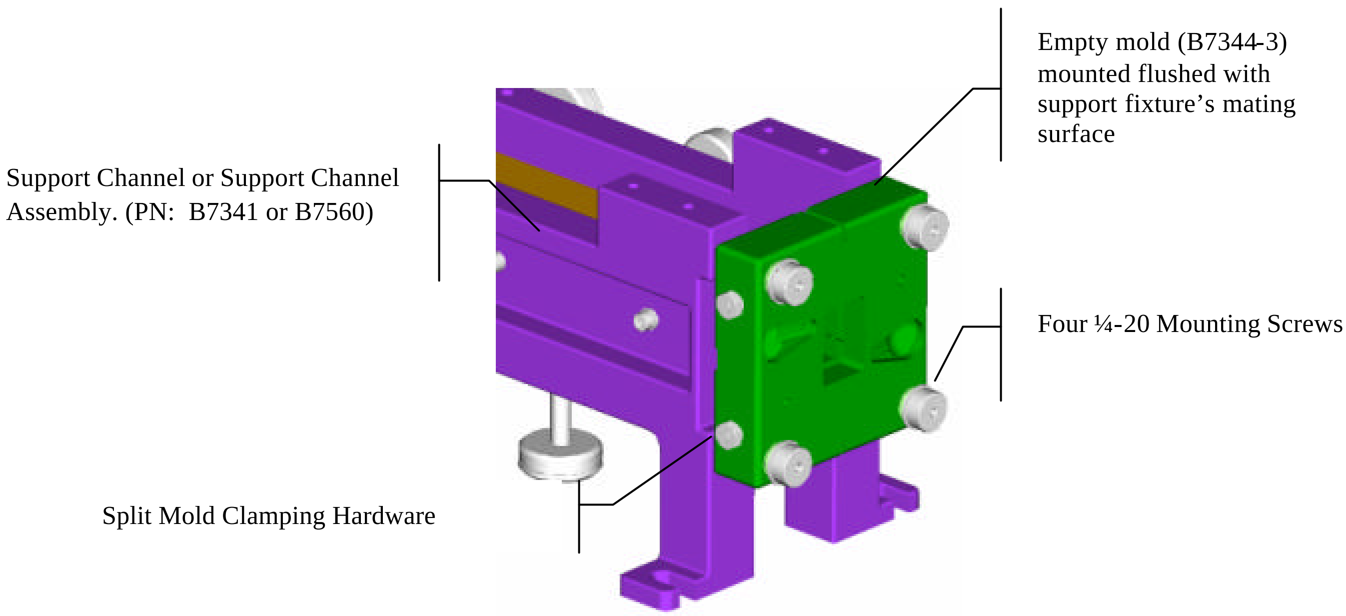


Figure 3: PN–B7340 Fixture Assy; Support Channel (B7560) & Empty Mold (B7344-3) View Shown

2. Retract all eleven thumbscrews and their Delrin swivel pads to their "full open" position to prepare for the crystal's insertion into the bonding set-up. (See Figure 4)

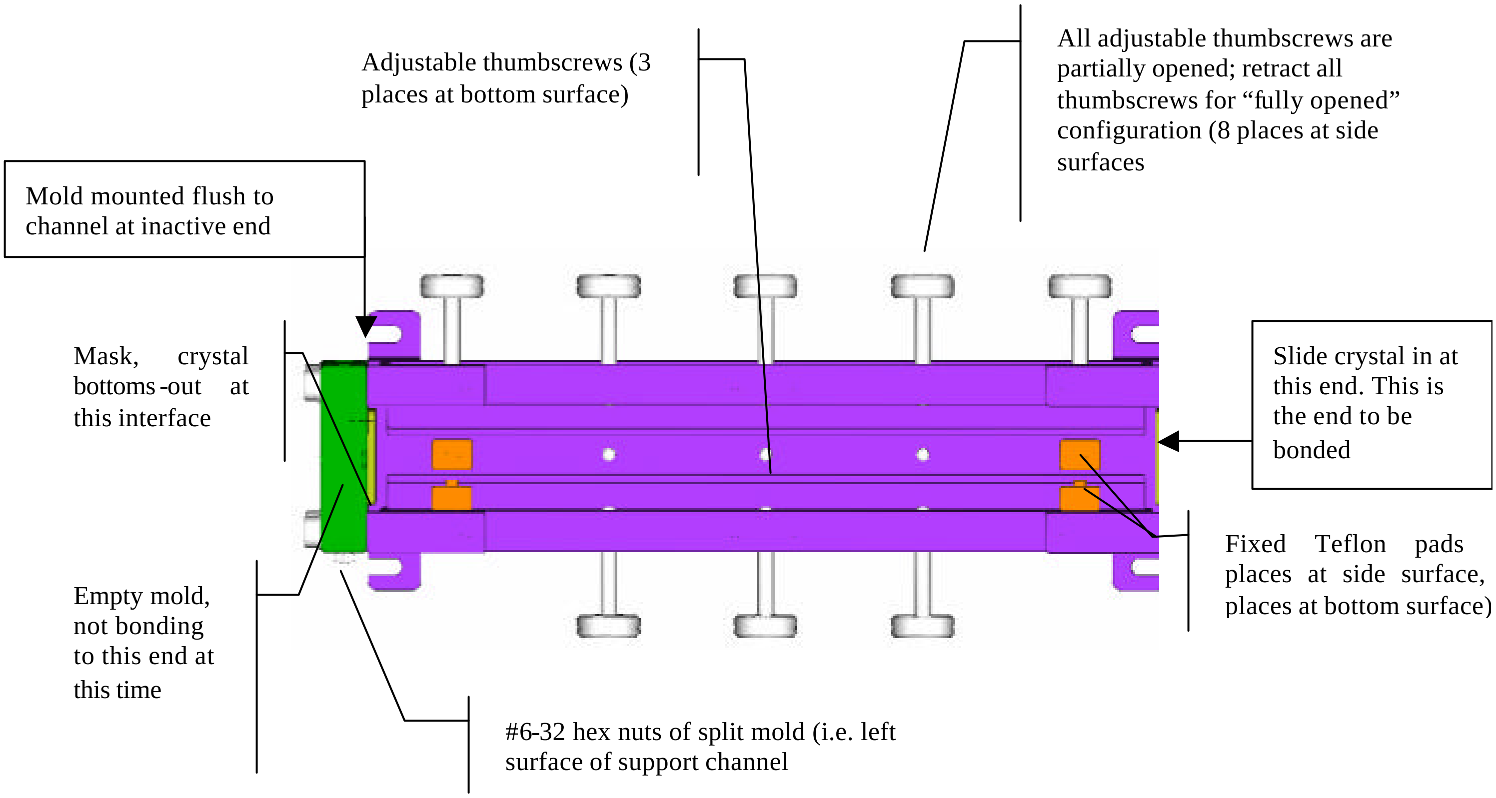


Figure 4: PN B7340 Fixture Assy.; Support Channel & Empty Mold Top View Shown

3. Mark the crystal and correlating PDA serial number on the support channel with an approved label.
4. Slowly insert the crystal into the set-up assembled thus far **with the crystal end that is not to be bonded to at this time going into the support channel first** and bottoming-out at the mask located in the empty mold (PN: B7344-3). (See Figure 4 for details.) In addition to this, orient the crystal in the bond set-up such that the crystal surface with the inscribed "V" is facing the left surface of the support channel (i.e. the side that contains the four #6-32 hex nuts for the split mold). (See Figures 4 & 5 for details.) Rest the crystal against the perpendicular fixed Teflon pads located in both ends of the channel.

<u>CAUTION:</u> The adjustable thumbscrews in the bond set-up assembly (PN: B7340) are intended to help support the crystal in the channel only. Do not over torque the screws to clamp the crystal in place else the crystal may be damaged.

5. While carefully observing the crystal from the top face of the channel, adjust the eight side thumbscrews until the swivel Delrin pads **<u>lightly</u>** touch the crystal. Begin with the five thumbscrews that are located on the side of the channel and work the screws one by one from the bonding end to the free end. (See Figure 5 for details.)

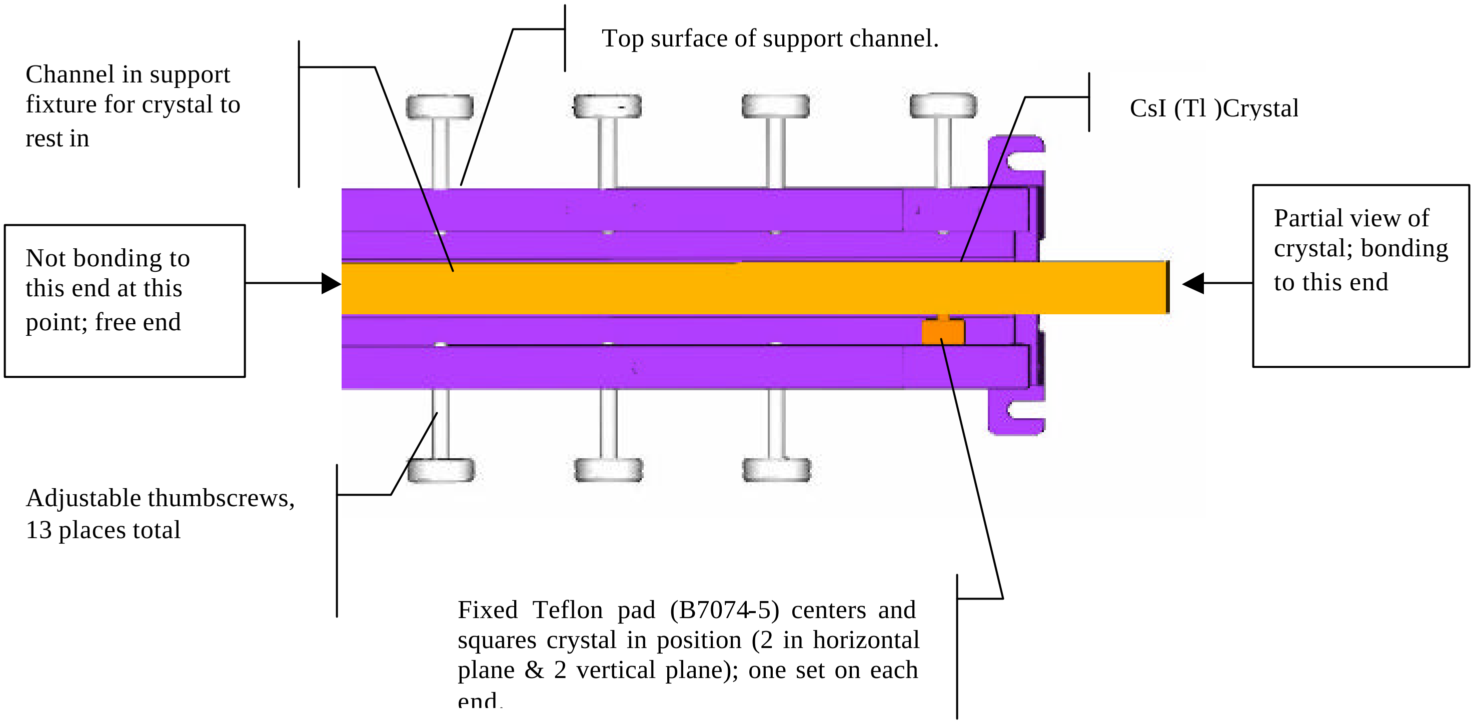


Figure 5: Support Channel & CsI Crystal; Crystal Insertion - Top View Shown

6. While observing the crystal down the length of the channel from the bonding end, carefully adjust the three bottom thumbscrews on the channel until the Delrin pads **<u>lightly</u>** touches the crystal bottom surface.
7. Assemble the center retainer (PN: B7355) to the channel and tighten the two or four #8-32 screws to secure it in place.
8. Assemble the cable protector (PN: B7559) to the support channel to the end that is not being bonded during this first bonding day. Tighten the two or four #8-32 screws to hold the item in place.
9. Adjust the twelfth thumbscrew attached to the cable protector until the Delrin pad **lightly** touches the crystal.
10. With the crystal securely held in place, vertically mount the bond set-up assembled thus far onto the worktable as shown in Figure 6. **Note that the end of the CDE that is to be bonded on this first day** is located in the top position of the bond set-up. Secure the set-up to the workstation by first hooking the bottom two mounting feet onto the waiting #¼-

28 bolts. While supporting the set-up, carefully lay the top mounting feet into their waiting #¼-28 bolts. Tighten the four bolts.

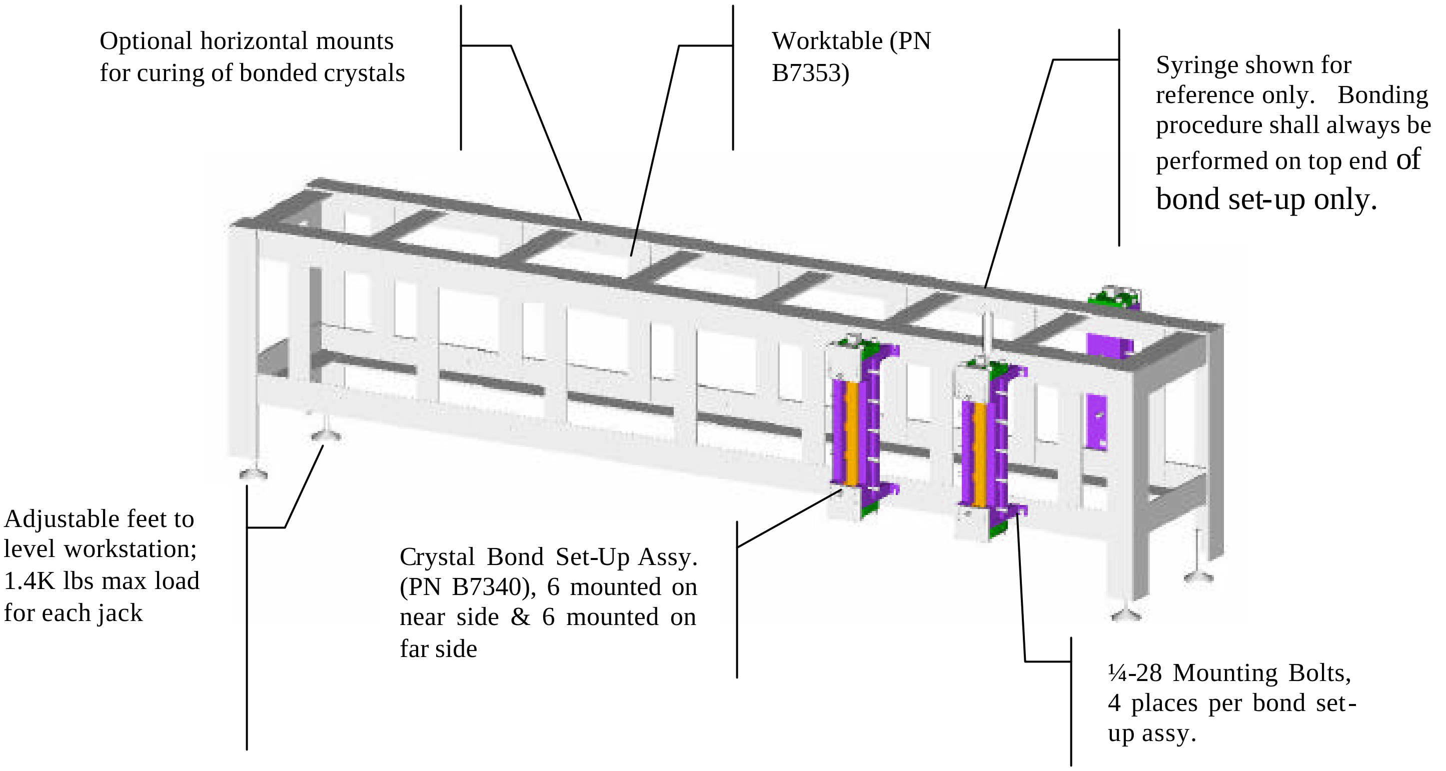


Figure 6: PN–B7562 Full Bond Set-up Assemblies on Worktable; Each Workstation Includes 12 Bond Set-ups (B7340) & 1 Worktable (B7353)

11. Repeat all steps from Section 6.4, "Setting Up the Crystal", for the remaining ten bond set-ups.

4.6 Priming Bonding Surfaces

1. Place the eleven mold-PDA subassemblies (PN: B7344-1) assembled previously in Section 6.3, *"Setting Up the PDA"*, on a flat surface with the diode's Epotek bond surface facing upward. The crystal and diode bonding surfaces are now ready to be primed.
2. Fill an approved glass microliter syringe or calibrated glass or approved Polypropylene micropipette with 6µL of primer DC92-023.

CAUTION: If the glass syringe used to prime the diodes and crystal do not have replaceable needles/tips, clean the syringe using 100% ethyl alcohol by rinsing the syringe and it's needle out at least 3 times before reusing the same syringe with a new batch of eleven CDE bonds. Dry thoroughly by blowing with dry nitrogen. If a disposable syringe tip is used for the priming process, dispose the syringe tips after each batch of 11 diodes and crystals are primed.

3. Deliver 6µL of primer near the center of the PDA bonding surface. Touch the tip of the needle to the PDA surface to ensure that the full amount is delivered.
4. Spread the primer evenly over the bonding surface by tilting the PDA and mold and/or also by using a 5-10mm blade from a polypropylene spatula.
5. Prime the remaining ten PDAs by following the same steps described above.
6. Record the priming start time for each diode in the Mix Log Record Form.
7. Fill an approved glass microliter syringe or calibrated glass or approved Polypropylene micropipette with 10µL of primer DC92-023.
8. Deliver 10µL of primer near the center of the crystal bonding surface. Touch the tip of the needle to the crystal surface to ensure that the full amount is delivered.
9. Spread the primer evenly over the bonding surface by using a 5-10mm blade from a polypropylene spatula.
10. Prime the remaining ten crystals by following the same steps described above.
11. Record the priming start time for each crystal in the Mix Log Record Form.
12. Allow the primer to air dry on both the diode and crystal for approximately 40-90 minutes at room temperature and typical humidity conditions.

    NOTE: *The pot life of the primer is no more than 1.5 hours.*

13. Perform a visual inspection of the diodes and crystals. The bonding surfaces should be visibly clean and contain a thin coat of primer.

4.7 Day 1: Bonding Process for 1st End of CDE

1. Just prior to bonding, prepare enough adhesive to bond 11 PDAs to their CDEs at the workstation. Use a glass eyedropper to deliver an accurate amount of DC93-500 into a clean-room approved polypropylene beaker. Use a calibrated centigram scale to achieve a precise "base" and "hardener" amount. Deliver 1 part by weight hardener to the mixing beaker. Deliver 10 parts by weight base to the mixing beaker. Record the actual weights of each part in the Mix Log Record Form.
2. Using a cleaned polypropylene stirring-rod, thoroughly blend the compound in the beaker. Mix for at least three minutes.
3. Degas the encapsulant in a vacuum until no entrapped air is visible. Release the vacuum as necessary to free the bubbles. Pump for at least 20 minutes. Continue the vacuuming process for 5 minutes after the bubbles have collapsed. Record the duration of the degassing time in the Mix Log Record Form.

CAUTION: The degassing process will cause foaming to occur. For best results, degas in a container that is no more than one third full to avoid foaming material overflowing the container. The pot life of the mixed encapsulant once the degassing process is completed is 1 hour.

4. While waiting for the encapsulant to finish its degassing process, complete the eleven bond set-up assemblies at the workstation as follows:
5. Retract the eight side thumbscrews to their open position so that the crystal is free to align itself to the bonding mold & PDA subassembly that is about to be assembled to the set-up.
6. Assemble the mold-PDA subassembly (PN: B7344-1) from the previous step in Section 6.3, "Setting Up the PDA", to the bond set-up. Use the dowel pins to align the mold-PDA subassembly to the support channel and crystal. (The mold and support channel interface surfaces will not be flushed against one another at this end. Value for ? x is dependent on crystal length. See Swales Aerospace assembly drawing B7340 for details.) Be sure that the crystal's bonding end is correctly resting in the mask's crystal cavity. (See Figure 7)

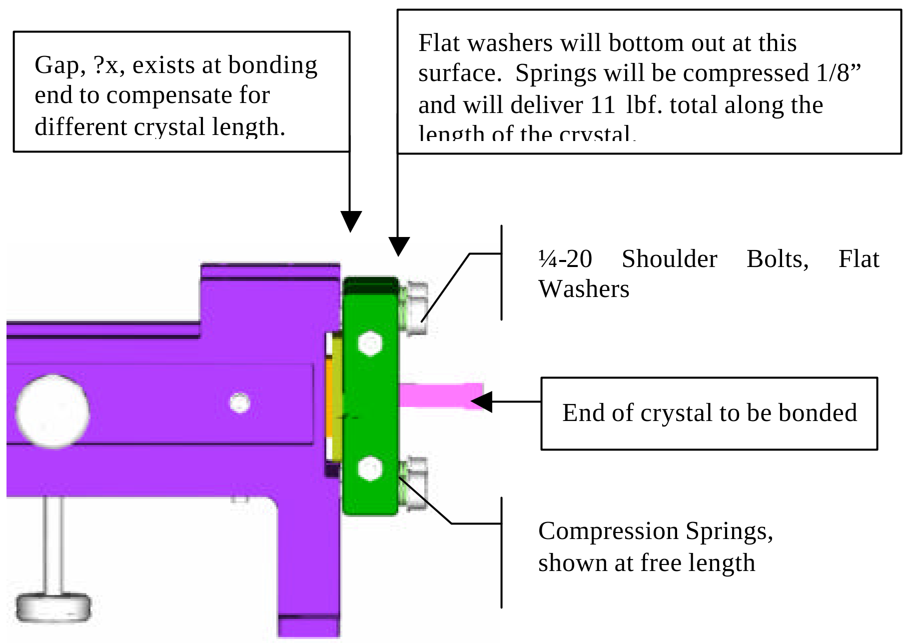


Figure 7: PN – B7340 Bond Set-up Assembly; Side View of Bonding End Shown

7. Preload the crystal to create a tight seal at the bonding surface by using four compression springs, #¼-20 shoulder bolts and washers as shown in Figure 7. Tighten the four bolts until the washers bottom-out at the top surface of the counter bored holes. (See Swales Aerospace assembly drawing B7340 for further details.)
8. The crystal and PDA should now be completely aligned and secured in the bonding set-up as shown in Figure 8.

NOTE: *Do not remove the slip fit dowel pins at the bonding end. The pins will help to support the mold and maintain alignment of the bond set-up assembly during bond the bond disassembly process.*

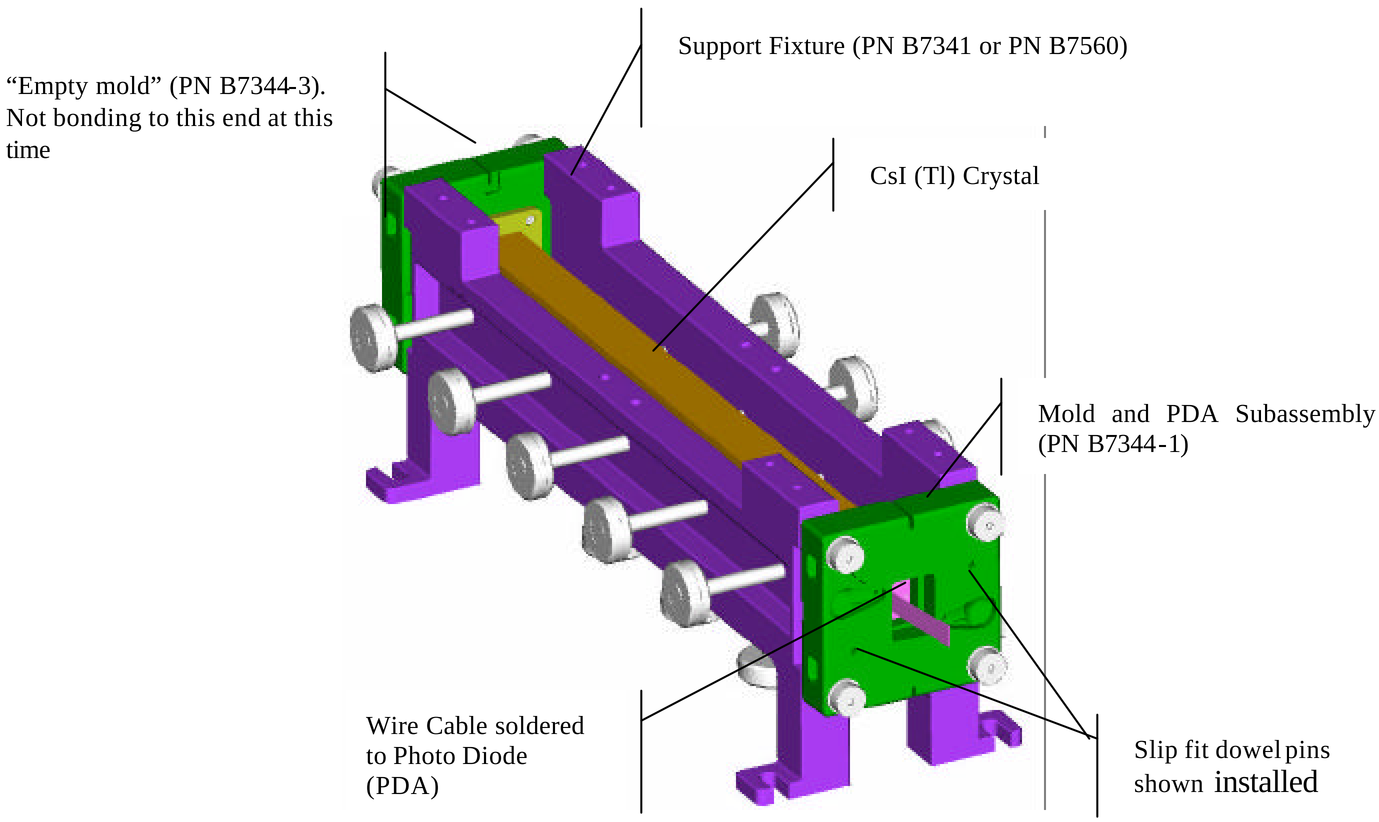


Figure 8: PN-B7340-1 Bond Set-up Assembly, Day 1

9. Readjust the eight side thumbscrews until the Delrin pads **lightly** touches the crystal sides.
10. Assemble the final component, the cable protector (PN: B7559), to bonding end of the bond set-up. Carefully position the wire cable into the cable protector and secure the item in place by tightening the two or four #8-32 bolts. (See Figure 9)
11. Adjust the remaining thirteenth thumbscrew located on the cable projector just incorporated into the set-up until the pad **lightly** touches the crystal along its top surface. (See Figure 9).

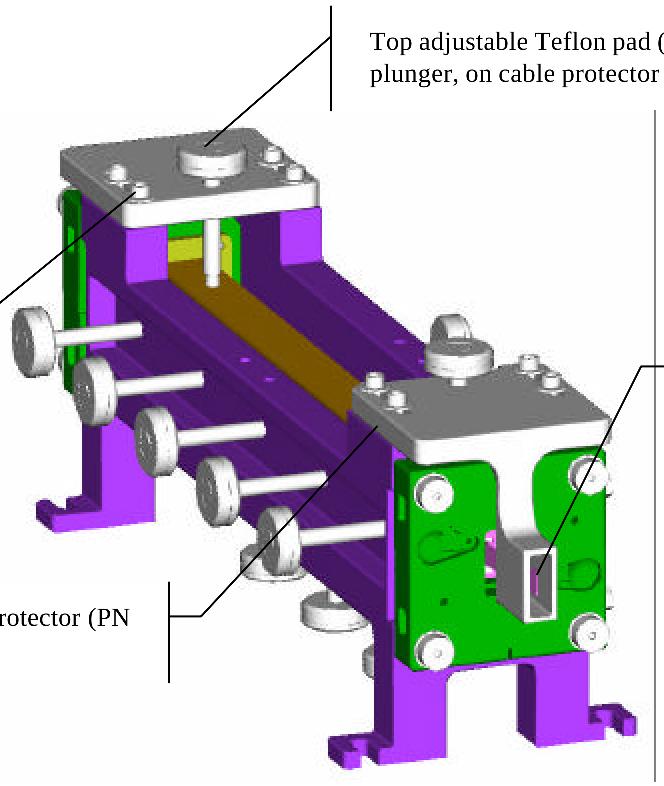


Figure 9: PN–B7340 Bond Set-up Assembly with Cable Protector; Bond End Shown

12. Repeat all preceding steps starting from Section 4.7, Day 1: Bonding Process for 1st End of CDE for ten more bond set-up so that one workstation of eleven CDEs can be bonded at one time. Log the crystal and corresponding PDA serial number in the WOA and CDE logbook.
13. The bond set-up for day one is now complete and is ready to be injected with the bonding material DC93-500.
14. Assemble a syringe with a 16-gauge needle (0.053” ID, 0.064” OD).

NOTE: *The needle gauge number might vary from one manufacture to another. Select needle gauge as necessary to maintain the desired inner diameter and outer diameter.*

15. While holding the syringe at an angle with the needle pointing downward, slowly fill the syringe with the degassed DC93-500. Pour the encapsulant down the side of the syringe slowly to minimize trapping air in the syringe cavity. Remove entrapped bubbles from the syringe before creating the bond.
16. Place the filled syringe into a glue gun. Adjust the gun as necessary to attain the pressure needed for proper injection. Be sure to keep the syringe in a vertical position with the needle end pointing downward so that bubbles are not introduced into the syringe at the needle end of the syringe.

17. Very slowly inject the DC93-500 into the mold inlet hole as shown in Figure 10. Continue the injection process until the encapsulant is visible at the outlet hole and approximately 15-30 seconds have passed since the appearance of the last bubble.

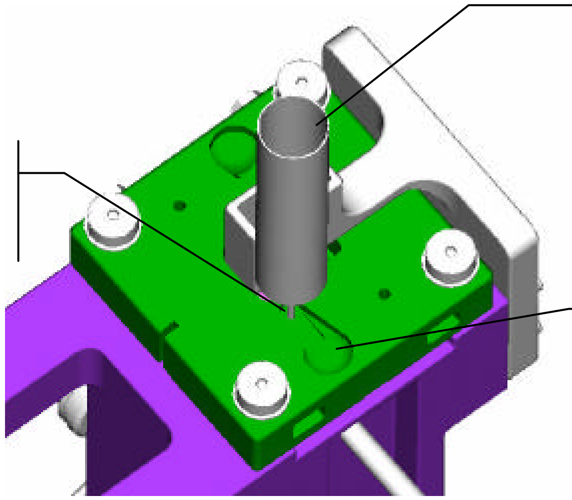


Figure 10: PN–B7562 Bond Set-up Assembly on Worktable, Injection View Shown

18. Using clean-room swabs and/or clean-room cloth, remove any over-flowed encapsulant from the mold inlet and outlet wells.
19. Record in the Mix Log Record Form the bond date and bond start time. (The bond start time begins when the 93-500 hardener is added to the 93-500 base during the mixing process defined in Section 4.7.)
20. Repeat injection and cleaning steps for the remaining 10 CDEs.
21. Allow the bond to cure for 24 hours before removing the mold or rotating the bond set-up 180° to perform the remaining bond on the opposite side.

NOTE: *This procedure is written such at each of the 12 bond set-ups are prepared and assembled from Section 6.2 – Section 6.6 one at a time before they are all bonded at the workstation. If it is more desirable to perform each section's steps for all 11bond set-ups before moving on to the next section, then the technician and engineer may do so once the CDE production task is began.*

4.8 Day 2: Bonding Disassembly Procedure for 1st End of CDE

The following steps should be performed 24 hours after the first bond for each CDE:

1. Record in the Mix Log Record Form the date and time the bond was released from the mold (i.e. bond "stop" time.)

2. Release the bonded PDA from the mold by first removing the four #¼-20 bolts and springs which secures the mold to the support channel.
3. After the mold is free of the support channel, remove first the two pin/bolts (PN: B7354) that hold the split mold together then remove the two dowel pins. Slowly separate the mold, split mask and split seal into their halves. (Do not remove the six #2-56 screws that secure the mask and seal to the mold so that the three parts could be separated together.)

CAUTION: Be careful not to pull or hit the cable protector that is still attached to the support channel and is also supporting the wire cable of the bonded diode.

4. Once the mold, mask and seal are free, carefully clean the crystal surface around the bonded area with a clean-room swab and 100% ethanol to remove any partially cured residual encapsulant. To avoid spreading alcohol onto the crystal side, minimize the amount of alcohol used.

CAUTION: Care shall be taken while cleaning the crystal surface around the bonded PDA to ensure that the bond itself is not stressed in any way. If cleaning process appears/proves to not be possible without disturbing the bond, notify project QA or responsible Engineer for further instructions.

5. Perform a visual inspection on the bonds just released from "day one" of the bonding process to ensure that bonds are mechanically good and do not contain any voids or bubbles.
6. Remove the bond set-up from the worktable by loosening the four #¼-28 bolts and place the set-up on a leveled surface.
7. Repeat the bond disassembly procedure from Steps 1 thru 5 for the remaining ten CDEs at the same workstation.
8. Set all used molds, mask and seals aside for cleaning. If the mask, seal and o-rings are damaged, the items shall be discarded and a new set shall be used.

4.9 Day 2: Set-up and Bonding Procedure for 2nd End of CDE

1. With the bond set-up removed from the worktable, loosen the ten thumb-screws located at the sides and top of the support channel (8 thumbscrews on the sides & 2 thumbscrews at the top) so that the crystal is free to slide along the channel's length
2. Remove the remaining "empty" mold (PN: B7344-3) from the support channel by loosening the four #¼-20 bolts. Separate the "empty" mold into its two halves so it can be used in the next step at the opposite bonded end from day one.
3. Assemble an empty mold to the end that was bonded in day one of the bonding process. Use the dowel pins to align the empty mold to the channel and crystal. Use the four #¼-20 shoulder bolts, compression springs, and washers to secure the mold flush to the end

surface of the support channel. See Swales Aerospace bond set-up assembly drawing B7340 for details.

4. Slowly slide the crystal towards the un-bonded end just enough so that the empty mold from the previous step can be mounted to the channel at the bonded end of the CDE. This empty mold will now act as the "end cap" for the new bond at the remaining end of the crystal. Tighten the four #¼-20 shoulder bolts.
5. Once the empty mold is secured in place, slide the CDE towards the empty mold until the bonded CDE end bottoms out at the mask interface.
6. Remove the cable protector at the end that is to be bonded so that a new mold and PDA assembly (PN: B7344-1) can be positioned in place for Day 2 of the bonding process.
7. Repeat Steps 1 thru 6 for the remaining ten CDEs of the same workstation.

NOTE: *This procedure is written such at each of the 11 bond set-ups are prepared and assembled for the second day bond one at a time before all 11 CDEs are bonded at the workstation. If it is more desirable to perform each section's steps for all 11 bond set-ups before moving on to the next section, then the technician and engineer may do so once the CDE production task is began.*

8. Repeat Steps 4 and 5 from Section 4.3.1, "Crystal Preparation" for the unbonded ends of all eleven bond set-ups.
9. Perform all steps from Section 4.3.2, "PIN Photodiode Assembly (PDA) Preparation" for the remaining twelve PDAs.
10. Repeat the steps from Section 4.4, "Setting Up the PIN Photodiode Assembly (PDA)", for all eleven bond set-ups.
11. Repeat the priming steps from Section 4.6, "Priming Bonding Surfaces", for a new diode and the un-bonded crystal end for all twelve CDEs.
12. Repeat bonding process in Section 4.7, "Day 1: Bonding Process for 1st End of CDE", for the 2nd end of the crystal for all eleven CDEs.
13. Repeat the bonding disassembly procedure from Section 4.8, "Day 2: Bonding Disassembly Procedure for 1st End of CDE", for all eleven CDEs on the workstation.
14. The eleven bond set-ups should now be completely removed from the bond worktable and the bond set-up should contain the complete bond set-up assembly, PN: B7340, less one of two mold & PDA subassemblies (PN: B7344-1).
15. Retract the two top thumbscrews with swiveling pads located in the cable protector.
16. Disassemble the remaining items from the bond set-up assembly by remove the parts in the following order:
    - Cable protector (2 places)
    - Center retainer (1 place)
    - Empty Mold (PN: B7344-3, the end bonded in day 1)

NOTE: *The empty mold shall be removed by first loosening the four 1/4 –28 bolts, then loosening the two pin/bolts. Once the mold is free of constraining hardware, slowly split the mold apart.*

17. Retract the eight side swivel pad thumb-screws and slowly remove the completed bond CDE from the channel by following the crystal handling procedure in Section 3.4.1.
18. Repeat the three disassembling steps described above for all eleven CDEs.
19. Perform a visual inspection on the bonds just released from "day two" of the bonding process to ensure that bonds are mechanically good and do not contain any voids or bubbles.
20. One set of eleven CDEs should now have both ends of the crystals bonded to photodiodes and wire cable. Reinsert each CDE into their final VM2000 wrapping and set the finished CDEs aside in an acceptable storage area and allow the bonds to reach the 7 days full cure. Record all bond start dates and times on the WOA form.

5.0 Post Process Inspection

5.1 Hardness

The shore hardness of the sample adhesive for each mixing lot should be in the range of 35-45, Shore A.

5.2 Appearance

The surface of all adhesive bonds shall meet the following requirements in addition to workmanship and appearance criteria of Section 3.1.1:

- Shall be in a fully cured state as defined to be tack free to the touch of a plastic probe.
- Shall have good adhesion and show no evidence of separation between the PDA and the crystal.
- Should be free of particulate contamination, such as dirt, hair, dust, etc.

6.0 Quality Assurance Provisions

6.1 Material Control

All materials used shall have been verified versus the appropriate documentation to their correct performance via a Standard Materials Certification (SMC) or Certificate of Compliance from the manufacturer. All materials shall be within their original shelf life and stored per the manufacturer's recommendations in terms of proper containers and storage environment.

The adhesive's trade name, mix ratio, manufacturer's lot number and expiration date shall be recorded in the manufacturing traveler or certification log.

6.2 Receiving Inspection

a) Receiving Inspection (RI) is responsible for inspecting all incoming material (i.e., PDA, crystal, etc), which will be used in the fabrication, assembly and bonding of all flight deliverable hardware. Applicable engineering drawings, specifications, standards or instructions shall be utilized to ensure complete compliance with all applicable requirements. All inspection and test equipment used for accepting incoming items and materials shall be calibrated. RI shall maintain records of all received material.

b) Where the incoming material is standard off-the-shelf, which is accepted on the basis of verification of count and condition, and validation that the item received is what is on the packing list. Receiving inspection shall verify the documentation on the material.

c) Prior to moving materials from Receiving Inspection, the QA department shall assure that all material is segregated and accompanied by the following documentation, as applicable.

- Purchase Order (and any automated data system instructions)
- Drawing
- Dimensional Data
- Test data
- Chemical and/or physical certifications applicable
- Sub-tier Vendor Certifications (if applicable)
- WOA form

d) RI shall verify that all purchase order requirements are satisfactorily met. If materials are received without the necessary documentation, the material shall be placed on hold. QA will obtain the necessary documentation prior to the release of the material. All materials released without proper documentation shall be subject to recall if the documentation problems are not resolved.

e) Limited life material shall be identified and processed in accordance with procurement documentation. A shelf life label shall be placed on all material identifying the expiration date, and Lot Control Number (LCN). All limited life materials shall be entered into the Limited Life Database system. Any special instructions shall be listed on the Cert Log or Work Instructions

6.3 Personnel Certification

Trained and competent technicians as determined shall perform processing in accordance with this specification. All personnel in contact with hardware shall be trained for ESD and clean room procedures.

6.4 Sampling for Acceptance Tests

The processed parts and their associated witness hardness samples shall be used to determine compliance with requirements specified herein. Do not discard sample for hardness. Submit to QA for retention along with mix log.

6.5 Facility Approval Inspection

Facility approval inspection is performed on sample units produced with equipment and procedures normally used in production. Facility approval inspection consists of all the examinations and tests in this specification.

6.6 Quality Conformance Inspection

Quality conformance inspection consists of all the tests and examinations performed on items, which have been submitted for acceptance and specified herein. All parts shall be inspected 100 percent for all requirements except hardness. Hardness shall be inspected on specimens prepared on a lot representative basis.

6.7 Lot Formation

A lot consists of all the assemblies of the same part number, processed in one 24-hour period, using the same batch of adhesive, by the same processing activity, in accordance with this specification, and submitted for inspection at one time.

6.8 Wrapping

It is the responsibility of all personnel to ensure that crystals are returned to their respective wraps and boxes after bonding. Each crystal shall be returned to its wrapper in the proper orientation, with the label on the “top” face – where the crystal is inscribed with a small V – and the characters on the label reading from left to right, where the “right” end is the end inscribed with the small V.

7.0 Tests

7.1 Hardness

Prepare a specimen cure concurrently with the hardware. An aluminum-foil weighing pan makes a suitable mold. Hardness shall be measured in accordance with ASTM D2240. The final hardness shall be documented in the mixing log.

7.2 Appearance

The appearance of all bonds shall be examined with a lighted magnifier having 4-10X magnification. All bonded assemblies shall be examined for conformance to workmanship requirement defined in 3.1 and herein.

7.3 Rejection

Failure of any required test stated in this specification shall be cause for rejection.

7.4 Surveillance

The cognizant Quality Assurance activity shall provide the surveillance necessary to verify conformance to this specification and processes.

7.5 Equipment Calibration

The cognizant Quality Assurance activity shall assure that the calibration system is in accordance with MIL-STD-45662.

Appendix A

Lap Shear Testing of Adhesive Joints

1.0 SCOPE

This method covers the determination of the shear strength of the adhesive material based on information derived from the lap shear technique of ASTM Test Method D 1002 (13.1).

2.0 APPLICABLE DOCUMENTS

ASTM Standard Test Method D 1002, Strength Properties of Adhesive in Shear by Tension Loading, ASTM Annual Book of Standards Vol. 03.01

3.0 PRINCIPLE OF METHOD

The specimen (crystal sample and PIN photodiode – nonflight) is loaded to failure and the apparent shear strength is reported. Note that the interpretation of the results depends on the nature of the failure, which may be adhesive or cohesive.

4.0 TERMINOLOGY

1. Shear strength – the stress at which the adhesive bond fails.
2. Adhesive failure – failure mode in which the failure surface is largely confined to the adhesive-substrate interface.
3. Cohesive failure – failure mode in which the failure surface is largely confined to the interior of the adhesive layer.

5.0 SIGNIFICANCE AND USE

This method is suitable for material qualification and quality control. It may also be used to generate design data with the application of the proper statistical procedures and for research and development on adhesive materials and joining techniques.

6.0 SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

1. Follow all area, process, and site guidelines and procedures regarding safety and environmental protection.
2. Eye protection is required while operating mechanical test frames.

7.0 Test Specimens

1. Test Specimens shall be made individually by bonding a representative PIN photodiodes and crystals. Crystal specimen features are the uniformity of the bond line and quality of the bond. Non-flight crystal and PIN photodiode (PINS removed) can be used
2. Attachment of fixture to crystal:

The fixture shall hold the crystal and PIN photodiode firmly in place.

3. Attachment of the loading fixture to the PIN photodiode:

   The loading fixture shall be bonded to the ceramic face of the PIN photodiode by using a Cyanoacrylate adhesive with adhesion strength a minimum of 5 to 6 times greater the adhesive used for bonding of the PIN photodiode to the crystal using a method described herein, which will not affect the existing bond between the PIN photodiode and the crystal. The assembly of the loading fixture shall be performed at room temperature or lower than at which the crystal and the PIN photodiode were bonded. The loading block shall be attached to the edge of the PIN photodiode in order to apply a shear load to the specimen.

4. Number of Specimens:

   The number of samples required for the test is 5 samples per adhesive mix lot.

8.0 CONDITIONING

It is preferable to perform assembly and test in a conditioning room with temperature and humidity control and perform the test under the same conditions as the flight assembly. This will provide specimens having uniform moisture content and a change in the moisture content will not occur during the test.

1. When required, the ASTM standard environment for conditioning and testing is 25°C ±5°C for temperature and 40% ± 5% for relative humidity (RH). Condition specimens for at least 24 hours before testing.
2. Other conditioning and testing environments may be required to produce data for special purposes.

9.0 PROCEDURE

1. Set up and calibrate the test machine following manufacturer’s recommended standard practice.
2. Measure the width of the joint and length of the overlap to the nearest 0.1mm.
3. Install the specimen in the grips, being careful to align the specimen and load axis.
4. Load at 1.3 mm/min (0.05 ipm) until failure.

10.0 CALCULATIONS

1. Calculate the shear stress as

$$\text{Shear Stress} = \frac{P}{W \times L}$$

Where: P = load, lb.

W = width of the joint, in.

L = length of the overlap, in.

2. Shear strength is the shear stress at failure.

11.0 ACCEPT/REJECT CRITERIA

A measured shear bond strength lower than 60 psi will be considered a failure.

12.0 REPORT

The test report shall include the following information:

1. Name of Test Operator.
2. Complete identification of each test specimen (adhesive/primer, crystal ID, PIN Diode ID, and bonding method).
3. Conditioning and test environment.
4. Test conditions (applied load and load speed).
5. Test results including ultimate strength, load/displacement data (plotted), type of failure, description of failed bond, of each specimen and statistical data of the overall tested lot.

Appendix B

STANDARD TEST METHOD FOR TENSILE STRENGTH VERIFICATION OF THE PIN PHOTODIODE TO THE CRYSTAL

1. Scope

This test covers the determination of tensile strength of the bond between the PIN photodiode and the crystal. The test consists of subjecting the PIN photodiode and crystal assembly to tensile load normal to the plane of the PIN photodiode. Such loads will be transmitted to the PIN photodiode through the thick bonding blocks bonded to the surface (For this test PINS of the photodiode shall be cut without affecting the integrity of the PIN photodiode prior to bonding the crystal).

This standard does not address all safety problems associated with its use. It is the responsibility of the user of the standard to establish appropriate safety and health practices and determine the applicability of regulatory limitation prior to use.

2. Terminology

Tensile Strength – tension normal to the plane of the PIN photodiode

3. Test/Machine Loading Fixture

The loading fixtures shall be self-aligning and shall not apply eccentric loads. A schematic of the test fixture is shown in Figure B.1. The loading blocks should be sufficiently stiff to keep bonded facings essentially flat under load. When the cross sectional area of the loading block is smaller than that of the PIN photodiode, it has been found to perform satisfactorily.

4. Test Specimens

1. Non-flight crystal and PIN photodiode (PINS removed) can be used.

2. Attachment of fixture to crystal.

   The fixture shall hold the crystal and PIN photodiode firmly in place.

3. Attachment of the loading fixture to the PIN photodiode.

   The loading block shall be bonded to the ceramic face of the PIN photodiode using a cyanoacrylate adhesive with adhesion strength of 2X to 3X greater than that of the adhesive used for bonding the PIN photodiode to the crystal. The assembly of the loading fixture shall be performed at room temperature or lower than at which the crystal and the PIN photodiode were bonded.

4. Number of Specimens

The number of test specimens shall be a minimum of 1 and a maximum of 2 and the method of their selection should be as defined herein.

5. Conditioning

It is preferable to perform assembly and test in a conditioning room with temperature and humidity control and perform the test under the same conditions as the flight assembly. This will provide specimens having uniform moisture content and a change in the moisture content will not occur during the test.

1. When required, the ASTM standard environment for conditioning and testing is 25°C ± 5°C for temperature and 40% ± 5% for relative humidity (RH). Condition specimens for at least 24 hours before testing.
2. Other conditioning and testing environments may be required to produce data for special purposes.

6. Safety, Health, and Environmental Information

1. Follow all area, process, and site guidelines and procedures regarding safety and environmental protection.
2. Eye protection is required while operating mechanical test frames.

7. Procedure

Apply tensile load at a constant rate of movement of the movable head attached to the PIN photodiode of the testing machine and at such a rate that the maximum load will within 1 minute.

8. Accept/Reject Criteria

A measured peel bond strength lower than 60 psi will be considered a failure.

9. Calculation

Calculate the tensile strength as follows:

Tensile Strength = maximum load / cross-section area

10. Reports

The test report shall include the following information:

1. Name of Test Operator.
2. Complete identification of each test specimen (adhesive/primer, crystal ID, PIN Diode ID, and bonding method).
3. Conditioning and test environment.
4. Test conditions (applied load and load speed).
5. Test results including ultimate strength, load/displacement data (plotted), type of failure, description of failed bond of each specimen and statistical data of the overall tested lot.

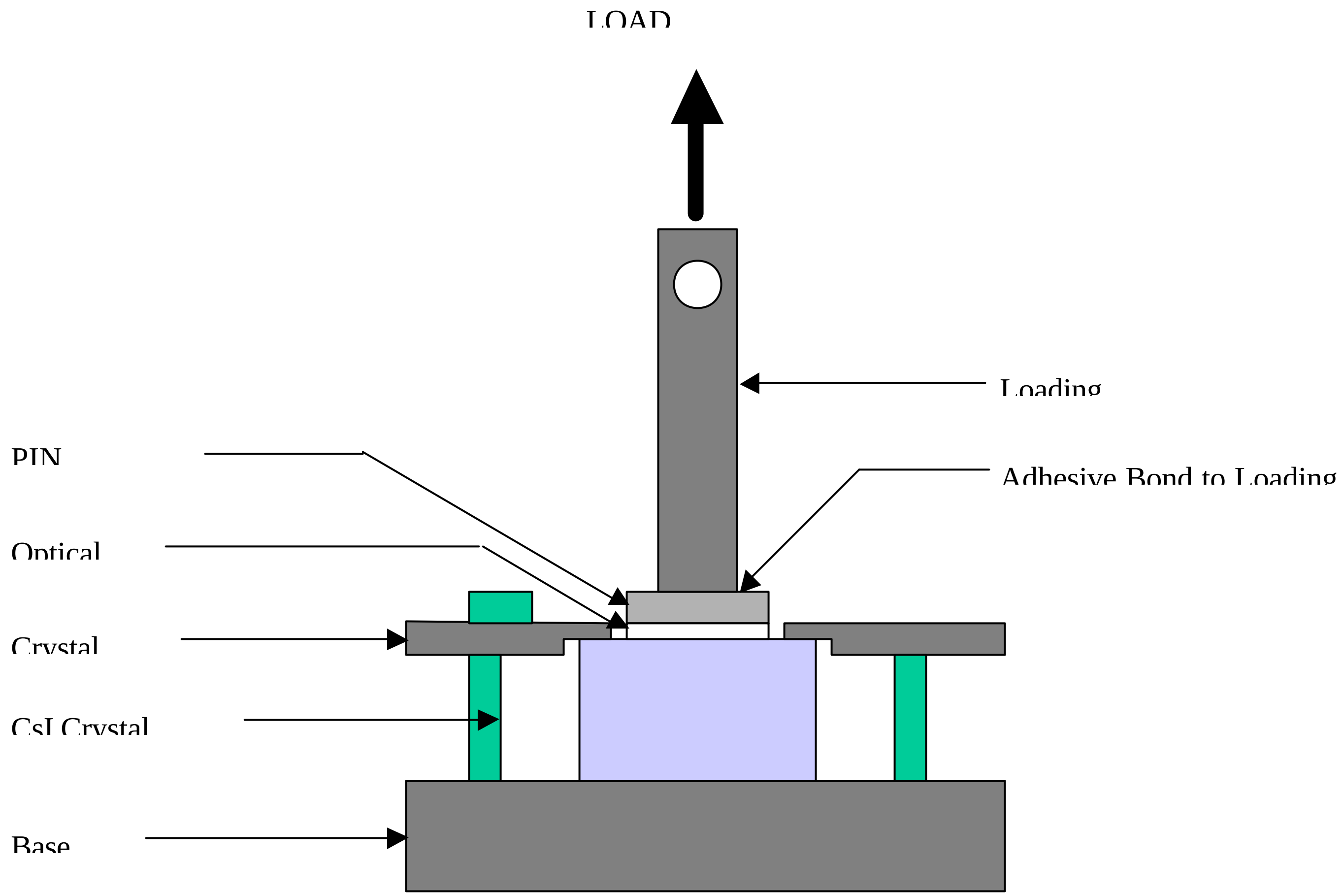

LOAD
Loading
PIN
Adhesive Bond to Loading
Optical
Crystal
CsI Crystal
Base

Figure B.1